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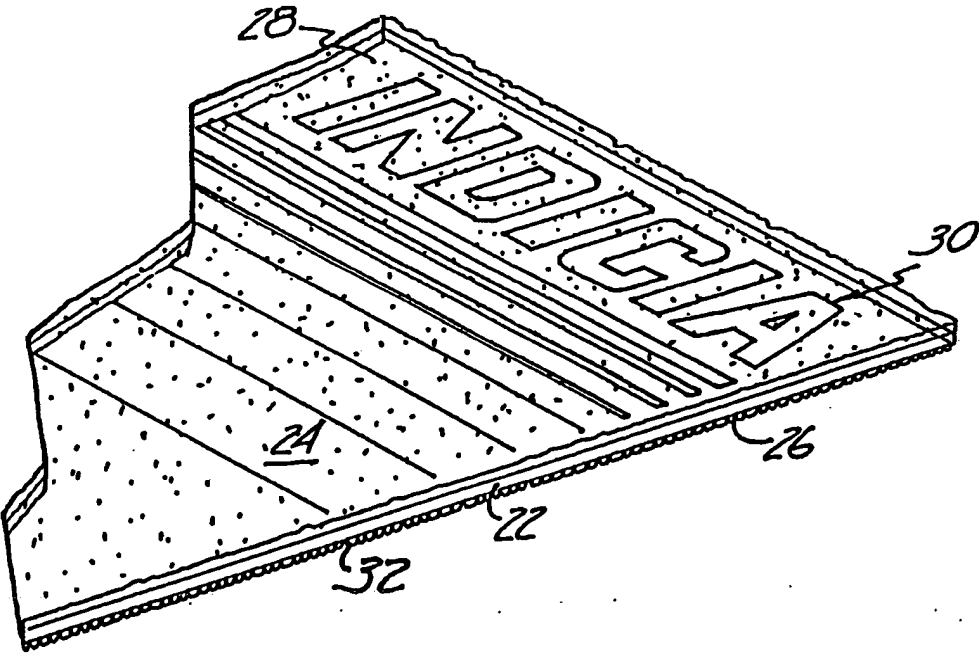
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b>  <b>B24D 3/00, 11/00, B42D 15/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 93/20976</b>  <b>(43) International Publication Date:</b> 28 October 1993 (28.10.93)
<b>(21) International Application Number:</b> PCT/US93/01789 <b>(22) International Filing Date:</b> 1 March 1993 (01.03.93)  <b>(30) Priority data:</b> 07/868,007                      13 April 1992 (13.04.92)                      US  <b>(71) Applicant:</b> MINNESOTA MINING AND MANUFACTURING COMPANY [US/US]; 3M Center, P.O. Box 33427, Saint Paul, MN 55133-3427 (US).  <b>(72) Inventors:</b> LINDHOLM, Gene, O. ; STERNER, Mark, L. ; TOCCI, Theodore, C. ; P.O. Box 33427, Saint Paul, MN 55133-3427 (US).  <b>(74) Agents:</b> OLSON, Peter, L. et al.; Office of Intellectual Property Counsel, Minnesota Mining and Manufacturing Company, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).		<b>(81) Designated States:</b> AU, CA, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> ABRASIVE ARTICLE  <div style="text-align: center;">  </div>		
<b>(57) Abstract</b>  <p>An abrasive article (20) includes a substrate (22) having a front side (24) and back side (26) with an abrasive material (28) bonded to the front side of the substrate. Indicia (30) are disposed on the substrate so that the indicia are viewable from the front side of the substrate in a normal non-mirror image readable from left to right.</p>		

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**ABRASIVE ARTICLE****BACKGROUND OF THE INVENTION**

5       The present invention relates generally to an abrasive article in which abrasive grains are bonded to a backing.

6       On an abrasive article, indicia in the form of printed information are placed on the back side, which is the side opposite from the front side. The front side  
10       contains the abrasive grains or grit. The indicia typically includes a grade number, a product name or other identification. The grade number refers to the average particle size or the particle size distribution of the abrasive grain. Printing on the back side of some prior  
15       art abrasive articles is incidentally viewable from the front side due to the substrate being translucent. However, the information is not readable since it is in a mirror image. Such a product has been sold under the trademark IMPERIAL MICRO FINISHING FILM by Minnesota  
20       Mining and Manufacturing Company of St. Paul, Minnesota.

      Abrasive articles are typically converted into a wide variety of forms such as sheets, discs, or belts. It is well known to attach the discs or sheets to a backup pad or support pad during use such as with a pressure  
25       sensitive adhesive.

      When the indicia is disposed on the back side of the abrasive article, the information cannot be seen if the abrasive article is opaque. If the abrasive article is translucent, only a mirror image of the indicia is seen  
30       and it is difficult to discern the indicia. Information which cannot be read by viewing the front of the abrasive article has several disadvantages. First, an operator may want to check the particular grade of an abrasive article if the operator forgets which grade of abrasive article is  
35       being used when the abrasive article is attached to a back-up pad or support pad. Secondly, if a second operator or new operator uses the same abrasive article, the second or new operator may not know the particular

grade of the abrasive article. In both instances, the operator has to remove the abrasive article from the pad in order to check the grade, the product identification, or the manufacturer. Then, if possible, the abrasive article is remounted on the back of the pad. If not, then a new abrasive article has to be attached to the pad. Another disadvantage relates to packaging of the abrasive article. Generally, in order to check the grade of the abrasive article, an abrasive article has to be removed from the package in order to view the indicia containing the grade designation.

The Steinhauser et al. U.S. Patent 3,849,949 discloses a concatenation of coated abrasive discs in which the non-abrasive side of the disc contains a pressure sensitive adhesive.

The Shaw U.S. Patent 4,437,269 discloses an abrasive sheet having indicia carried on its rear face overlaid by a translucent textile material providing a surface engagable by hooks. The material being adhered to the indicia and information content remain discernible through the textile material.

The Ott U.S. Patent 4,609,581 discloses a coated abrasive sheeting that is adhered to a backup pad by means of a loop material on the rear surface of the coated abrasive sheet. The loop material comprises a carrier web with a multiplicity of multi-filament yarns stitched into the coated abrasive backing with portions of the yarns providing the loops.

### SUMMARY OF THE INVENTION

The present invention includes an abrasive sheet having a substrate with a front and back side. An abrasive material is adhered to the front side of the substrate. Indicia are disposed on the substrate and are viewable from the front side of the substrate in a non-mirror image readable from left to right.

In one preferred embodiment, the indicia are disposed on the back side of a substrate that is light

transmissive. In another preferred embodiment, the indicia are disposed on the front side of a substrate which may or may not be light transmissive.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of an abrasive article of the present invention.

Figure 2 is a perspective view of an abrasive article of the present invention with indicia being disposed on the front surface thereof.

Figure 3 is a perspective view of the abrasive article of the present invention with indicia being disposed on a back surface thereof and readable from the front surface.

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#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An abrasive article of the present invention is generally indicated at 20 in Figure 1. Abrasive article 20 includes a backing or substrate 22 which has a front side 24 and a back side 26. An abrasive material 28 is bonded to the front side 24 using a suitable adhesive 25 or other bonding means now known or later developed. Indicia 20 are positioned either on the front side 24 as illustrated in Figure 2 or on the back side 26 and viewable on the front side 24 as illustrated in Figure 3. In both instances, the indicia are viewable in a non-mirror image readable from left to right from the front side of the abrasive article.

As illustrated in Figure 2, the indicia 30 are applied to the front side 24 of the substrate 22. The indicia are preferably applied to the substrate 22 prior to adherence of the abrasive material 28. The indicia 30 are readable in a non-mirror image from left to right when viewed from the front side of the substrate 22.

As illustrated in Figure 3, the indicia 30 are positioned on the back side 26 of the substrate 22. The substrate 22 is light transmissive. By light transmissive is meant that the substrate is sufficiently transparent so

that the indicia are viewable from the front side 24. Light transmissive substrates may be translucent, clear, transparent, or lucid. The indicia are applied to the back surface 26 in a mirror image,, and therefore when  
5 viewed from the front side, the indicia are viewable in a non-mirror image readable from left to right. A layer of colorant may also then be applied to the back side of the substrate over the indicia with the colorant layer being in a contrasting color to the indicia to enhance  
10 readability.

The indicia that are applied may include standard information that is typically found on an abrasive sheet. Such information includes the thickness of the sheet, the grit size, a product designation number,  
15 and manufacturer.

If the indicia are disposed on the front side 24, the substrate 22 may include either light transmissive or opaque materials such as paper, fiber, cloth, polymeric film, non-woven webs and combinations and treated versions  
20 thereof. If, however, the indicia are disposed on the back side 26, then the substrate must be at least translucent. Examples of such substrates include polymeric films such as polyester film, polyethylene film, and polypropylene film.

It is preferred that the front and/or back surface of the polymeric film contain a primer to increase the adhesion to the adhesive. The primer can be a surface alteration or chemical type primer. Examples of surface alterations include corona treatment and scuffing to  
25 increase the surface area. Examples of chemical type primers include ethyl acrylic acid copolymer and aziridine type materials as disclosed in U.S. Patent 4,749,617.  
30

Preferably, the abrasive grains should also be light transmissive. Examples of typical abrasive grains  
35 used for abrasive material 28 include silicon carbide, aluminum oxide, white aluminum oxide, ceramic aluminum oxide, cerium oxide, diamond, cubic boron nitride, boron carbide and mixtures thereof. Although typical abrasive

grains are somewhat opaque, the particles as a layer on the substrate still have light transmissive properties such that the indicia of the present invention clearly show through the layer of abrasive grains. Furthermore, in abrasive articles in which the abrasive grains are spaced from each other (sometimes referred to as "open coat"), the opacity of the individual abrasive grains is even less of an obstruction to viewing the indicia. Translucent abrasive grains are preferable such as white aluminum oxide to aid in the readability of the indicia from the front side of substrate 22.

The adhesive used to adhere the abrasive material to the substrate is preferably also light transmissive to aid in the readability of the indicia from the front side of the substrate 22. Examples of typical adhesives include polyester resins, urethane resins, acrylate resins, phenolic resins, glue, urea-formaldehyde resins, melamine resin and mixtures thereof. Such adhesives are applied at a thickness normally used for adhering abrasive material to a substrate. In one preferred embodiment, polyester film substrate approximately 70 microns thick was primed with an ethylene acrylic acid copolymer primer. An abrasive white aluminum oxide in the range of 1 to 100 microns in particle size was bound with a resole phenolic resin.

The indicia can be applied using a wide variety of well-known methods, which apply an ink onto the substrate. Such methods include letterpress printing, lithographic printing, gravure printing, and screen printing. Letterpress printing is preferably used. Letterpress printing involves a printing element that consists of a raised surface, wherein the surface can be a line, a word, a point or any type of figure. In letterpress printing, the printing ink is applied to the raised surface and then pressed onto the substrate 22 to cause the printing ink to transfer the specified pattern onto the substrate 22. In lithographic printing, an indirect image transfer is made where the inverse of the



printing plate is transferred to the substrate 22.

Lithographic printing is also known as offset printing or planographic printing. In gravure printing, a master tool

5 r roll is engraved with minute wells. The printing ink fills these wells and the excess printing ink is removed by a doctor blade. The ink in the well is then

transferred to the substrate 22. The size and the shape of the well determines the pattern on the substrate 22.

10 In screen printing, the printing ink is brushed through a stencil image on a fine screen and then onto the substrate 22. The stencil image forms the pattern that is

transferred to the substrate 22. More detailed information on printing techniques is found in Printing Inks, Kirth-Othmer Encyclopedia of Chemical Technology 19, 15 110-163 (3d ed. 1982) incorporated hereinafter by reference.

The abrasive article 20 is produced into a wide variety of forms such as sheets, discs, or belts. The discs or sheets are attached to a back-up pad 31 that  
20 drives abrasive article 20 to abrade a work piece (not shown) as illustrated in Figure 1. The back-up pad is used to support the abrasive article 20 during abrading. The back-up pad can be made from any material, although it is preferred that the material have at least some  
25 elasticity so that the material flexes during the abrading process. Examples of suitable materials include metal, rubber such as neoprene rubber, butyl nitrile rubber, plastics such as thermoplastics including nylon, polypropylene, acrylonitrile butadiene styrene copolymer,  
30 thermosetting plastics, and reinforced plastics, and polyurethane foam. The back-up pad is generally circular in nature and ranges in diameter from 1 to 40 cm and preferably in the range of 5 to 25 cm. Generally, the diameter of the abrasive article is slightly larger than  
35 the diameter of the back-up pad. By slightly larger is meant that the diameter of the abrasive article is between about 0.1 mm to about 2 mm larger than the back-up pad.

In one embodiment of the present invention, a pressure sensitive adhesive is applied to the back side 26 of the substrate 22 to allow the abrasive article 20 to be easily attached to the pad. The pressure sensitive adhesive must have sufficient adhesive strength to secure the coated abrasive to a support pad during use. Representative examples of pressure sensitive adhesives suitable for this invention include latex crepe, rosin, acrylic polymers and copolymers such as polybutylacrylate, polyacrylate ester, vinyl ethers such as polyvinyl n-butyl ether, alkyd adhesives, rubber adhesives such as natural rubber, synthetic rubber, chlorinated rubber, and mixtures thereof. A preferred pressure sensitive adhesive is an isooctylacrylate:acrylic acid copolymer.

The abrasive article 20 can also be attached to the pad 31 by a hook and loop fastening system. A hook and loop fastening system typically includes a loop portion 32 and a hook portion 34. A suitable hook and loop fastening system is sold by Minnesota Mining and Manufacturing Company of St. Paul, Minnesota. Preferably, the loop portion is laminated to the back side 26 of the substrate 22. The hook portion is then attached to the pad 31. The hooks then engage between the loops to attach the abrasive article to the pad. Of course, the loop portion can be attached to the pad, and the hook portion can be attached to the substrate. The loop material can be any type of textile material which has loops projecting therefrom. Examples of suitable textile materials include cotton, polyester, nylon, rayon, and the like. The loop materials can be multifilament yarns which are described in detail in Ott U.S. Patent 4,609,581, incorporated hereinafter by reference. Other types of loop materials are woven or knitted yarns having filament loops or curls extending from the surface. In one embodiment, the loop material is an opaque color to improve the readability of the indicia viewed from the front side of the substrate 22.

To produce an abrasive sheet material that will withstand a large number of disengagements from and reengagements with the hooks on the support pad it is necessary to apply an adhesive coating 36 such as

5 thickened or foamed latex, extruded polymer film, or hot melt adhesive to adhere the loops to the back side 26. The hot melt adhesive or other bonding material adhering the loops to the back side 26 may be colored prior to lamination of the loops to further improve the readability

10 of the indicia from the front side of the substrate 22.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and

15 scope of the invention.

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## CLAIMS:

1. An abrasive article (20) comprising:  
a substrate (22) having a front side (24) and a  
5 back side (26);  
an abrasive material (28) bonded to the front  
side of the substrate; and  
indicia (30) disposed on the substrate,  
substantially all the indicia being viewable from the  
10 front side of the substrate in a non-mirror image readable  
from left to right.
2. The abrasive article (20) of claim 1 wherein  
the substrate (22) is light transmissive and the indicia  
15 (30) are disposed on the back side of the substrate.
3. The abrasive article (20) of claim 1 wherein  
the substrate (22) is opaque and the indicia (30) are  
disposed on the front side of the substrate.  
20
4. The abrasive article (20) of claim 1 wherein  
the abrasive material (28) is light transmissive.
5. The abrasive article (20) of claim 1 and  
25 further comprising:  
an adhesive (25) adhering the abrasive material  
(28) to the front side (24) of the substrate, the adhesive  
being light transmissive.
6. The abrasive article (20) of claim 1 and  
30 further comprising:  
means for releasably attaching the article to a  
support pad (31).
7. The abrasive article (20) of claim 6 wherein  
35 the means for releasably attaching includes a hook and  
loop fastener having a first portion (34) containing a  
plurality of hooks and a second portion containing a

plurality of 1 ops (32) and wherein either the first or the second portion is attached to the back side of the substrate and wherein then the other first or second portion is attached to the support pad (31).

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8. The abrasive article (20) of claim 7 and wherein the portion of the hook and loop fastener attached to the substrate is opaque.

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9. The abrasive article (20) of claim 8 and further including:

an adhesive (36) for adhering the portion of the hook and loop fastener to the back side of the substrate (22).

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10. The abrasive article (20) of claim 9 wherein the adhesive is opaque.

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11. The abrasive article (20) of claim 1 wherein the substrate (22) is a light transmissive polymeric film and the indicia are disposed on the back side of the polymeric film.

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12. The abrasive article (20) of claim 11 and further including a layer of colorant disposed over the indicia (30), the colorant being in contrasting color to the indicia.

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Fig. 1

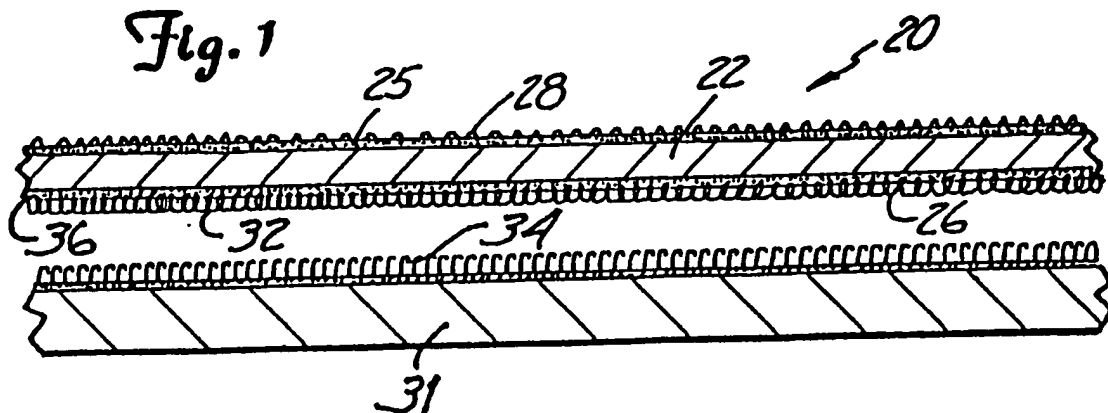


Fig. 2

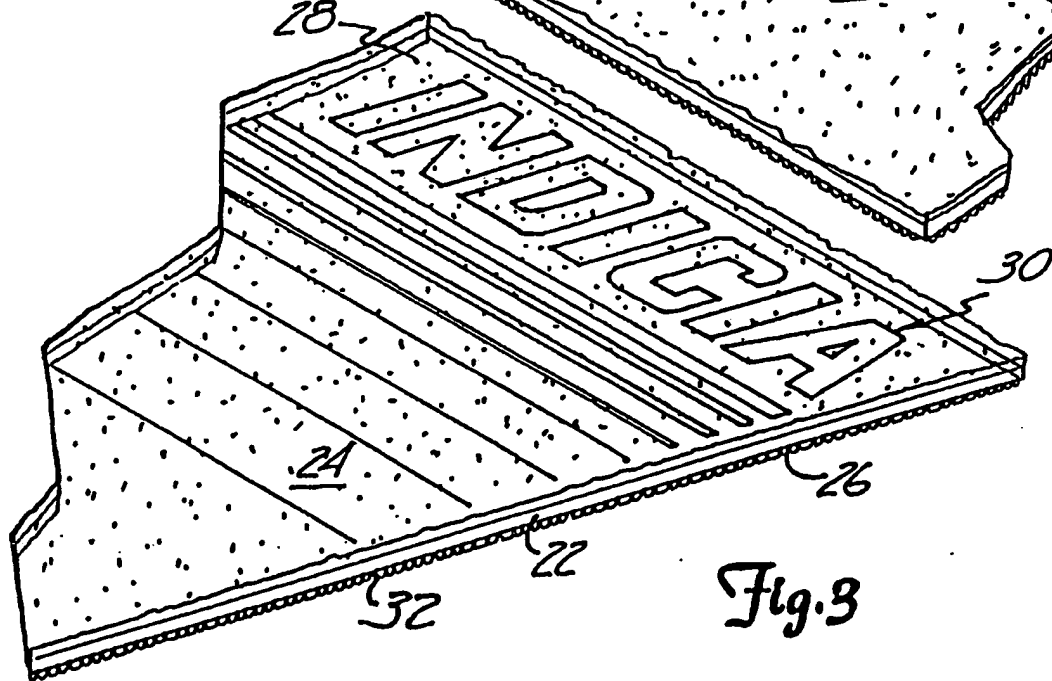
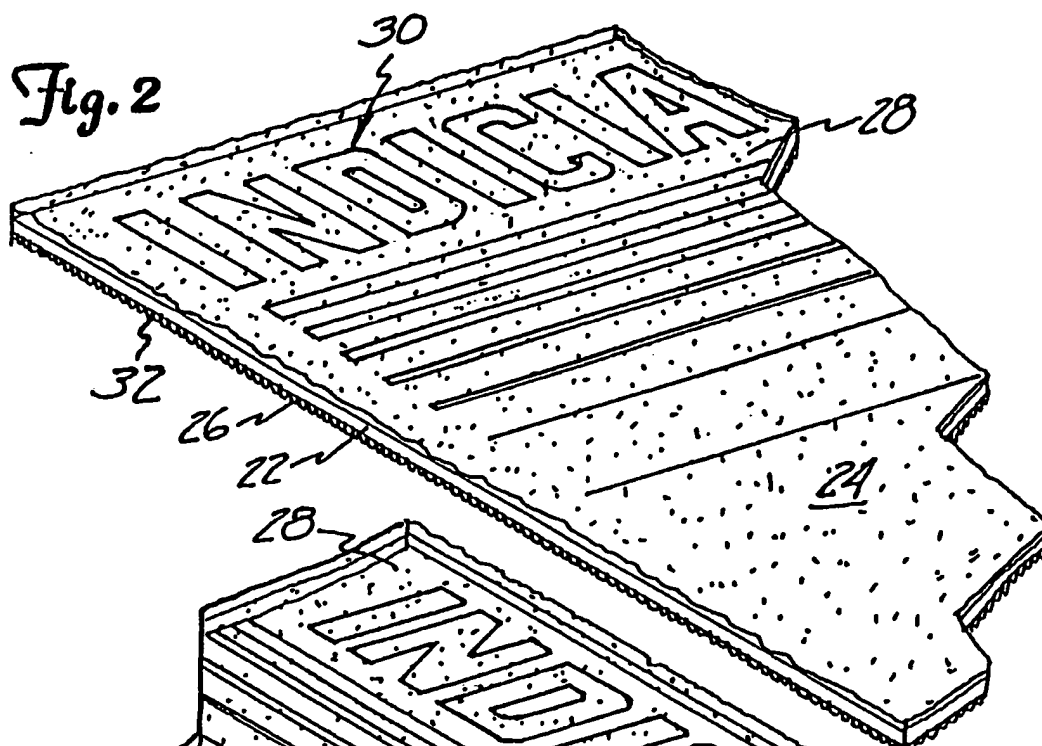


Fig. 3

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 93/01789

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 B24D3/00; B24D11/00; B42D15/00		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	B24D ; B42D ; B32B ; B24B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 112 (M-298)(1549) 25 May 1984 & JP,A,59 019 678 ( NIHON REJIBON SEITO K.K. ) 1 February 1984 see abstract ---	1,2,3,5, 10,11,12
A	WO,A,9 109 705 (ROBERT BOSCH GMBH.) 11 July 1991 see the whole document ---	1,2,6
A	US,A,4 437 269 (GEORGE SHAW) 20 March 1984 cited in the application -----	1,2,6,7
<p><sup>10</sup> Special categories of cited documents : <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
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US 9301789  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9109705	11-07-91	DE-C- 3942301	14-02-91
		EP-A- 0460133	11-12-91
		US-A- 5167095	01-12-92
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US-A-4437269	20-03-84	GB-A- 2056332	18-03-81
		GB-A- 2077640	23-12-81
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